Comparison of Effectiveness of 4% Articaine Associated With 1 : 100,000 or 1 : 200,000 Epinephrine in Inferior Alveolar Nerve Block

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This comparative study using 20 healthy volunteers evaluated the anesthetic efficacy of 4% articaine in association with 2 different concentrations of epinephrine, 1 : 200,000 (G1) and 1 : 100,000 (G2). The first premolars were tested with a pulp tester to verify the anesthesia induced by the inferior alveolar nerve block. The following parameters were measured: period of latency (PL; interval between the end of anesthetic injection and absence of response to the maximum output—80 reading—of the pulp tester); complete pulpal anesthesia (CPA; period in which the subject had no response to maximal output of the pulp tester 80 reading); partial anesthesia (PA; interval between the first reading below 80 and the return to basal levels); and the anesthesia of the soft tissues (AST; period of time from onset of anesthesia until the return to normal sensation of the lip). The Wilcoxon test (α = 0.05) was used to analyze the data. No significant difference was found regarding PL (P = .47), CPA (P = .88), PA (P = .46), and AST (P = .85). The results indicated that both solutions presented the same clinical effectiveness in blocking the inferior alveolar nerve.

Key Words: Articaine; Alveolar nerve block; Epinephrine.

Inferior alveolar nerve block is often used in clinical dentistry. It provides at least 1 hour of pulpal anesthesia in about 85% of the cases when local anesthetics with intermediate duration and equivalent potency associated with a vasoconstrictor are used.[1] In order to reduce the risk of adverse reactions, local anesthetic solutions must contain the minimum concentration of vasoconstrictors.[2(pp300-339),3-5]

Articaine is a local anesthetic that belongs to the amide group. It has a thiophene ring in the molecule that increases its liposolubility and potency.[1] The other amide anesthetic molecules have a benzene ring.[6] The anesthetic latency and duration produced by articaine is similar to local anesthetics such as lidocaine, prilocaine, and mepivacaine when they are associated with a vasoconstrictor.[7,8(p50)] Articaine should always be used in association with a vasoconstrictor because of its vasodilatation properties.[9]

Previous studies[9-12] have evaluated the anesthetic activity of articaine in comparison with other anesthetics or in association with 2 distinct concentrations of epinephrine: 1 : 100,000 and 1 : 200,000 using infiltrative anesthesia. No significant difference was found between 4% articaine in association with 2 concentrations of epinephrine, except that in the case of epinephrine 1 : 100,000 the period of latency was smaller.

No previous studies have shown differences in the anesthetic activity after inferior alveolar block of 4% articaine in association with these 2 concentrations of epinephrine. Most of these previous studies compared articaine with other anesthetics such as 4% prilocaine with 1 : 200,000 epinephrine or 2% lidocaine with

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1 : 80,000 or 1 : 100,000 epinephrine.[13–15] As the clinical observations on the effectiveness of 4% articaine associated with 2 distinct concentrations of epinephrine are insufficient, this study aims to compare the local anesthetic activity of 4% articaine associated with 2 distinct concentrations of epinephrine 1 : 100,000 and 1 : 200,000 in blocking the inferior alveolar nerve.

METHODS

The 2 anesthetic solutions used in this study were 4% articaine with 1 : 100,000 and 1 : 200,000 epinephrine (Septanest; Spécialités Septodont, Saint-Maur-des-Fossés, Cedex, France). Electrical pulp tester stimulus was used to assess the anesthetic activity (Vitality Scanner model 2006; Analytic Technology Corp, Redmond, Wash). Clinical assessment of local anesthesia with electrical stimulation of a previously selected tooth has proved to be a viable and useful method for quantifying pain[16,17] without histological damage to the dental pulp.[18] In this study the right inferior first premolar was the selected tooth.

Twenty volunteers (7 men and 13 women) aged 20–35 years (23 ± 4) and classified as healthy individuals were used for the study. They did not use any medication 1 week prior or during the experiment. Only the subjects having the right inferior first premolars free of caries and restorations were included.[19] The study was approved by the Ethical Committee of Piracicaba Dental School (protocol number 056/2000). All volunteers signed a written consent form.

In this double blind random study, the solutions were codified by an individual involved neither in the administration of the anesthetic solutions nor in pulp testing procedures. Both solutions were randomly applied to the subjects at 2 different sessions with a washout interval of at least 15 days.

The anesthesia of the inferior alveolar nerve was performed according to the technique described by Roberts and Sowray.[20(pp115–117)] The same operator executed all the anesthesia using self-aspirating syringes (Duflex, São Paulo, Brazil) and 27G long needles (BD, São Paulo, Brazil). After palpation of the external oblique ridge, the needle punctured the tissue at a point bisecting the guide fingernail and about 5 mm medially to it. Mandibular-angle bone was reached after 2–2.5 cm of needle insertion. The barrel of the syringe laid midway between the left lower premolars. After reaching the target area, aspiration was performed and the solution was deposited at a rate of 1 mL/min during the nerve block technique; slow introduction of anesthetic solutions produces safer and less traumatic anesthesia.[19] The same operator used standardized anesthetic volumes (1.8 mL).

The pulp tester was first used before anesthetic solution injection in the selected tooth in order to evaluate basal levels of reaction to electrical stimulus so the basal threshold could be determined. Immediately after the injection, electrical stimulus was applied every 2 minutes to obtain the period of latency. These 2-minute intervals were used to avoid nerve fiber accommodation, which is a phenomenon that could happen after repeated electrical stimulus in the same tooth.[21,22]

After the latency period, electrical stimuli were used every 10 minutes and stopping at previous verified basal levels. The following parameters were evaluated:

- Period of latency (PL): interval between the end of anesthetic injection and the absence of response to the maximum electrical stimulus (maximum output = 80 reading);
- Complete pulpal anesthesia (CPA): period in which the subject had no response to maximal output of the pulp tester (80 reading);
- Partial anesthesia (PA): interval between the first reading below 80 and the return to basal levels; and
- Time of anesthesia of the soft tissues (AST): period of time from onset of anesthesia, when the subjects reported lip numbness, until the return to normal sensation. Each subject was asked to record the time of return to normal sensation in the right lower lip.

Statistically significant differences between both anesthetic solutions regarding each parameter were verified by using the Wilcoxon nonparametric test (α = 0.05) of Bioestat 2.0 for Windows (Fortaleza, Brazil). Figure 1 shows how these parameters were evaluated in the present study.

RESULTS

All subjects reached 70–260 minutes (mean = 168 minutes) of sustained 80 readings for the epinephrine 1 : 200,000 group and 70–250 minutes (mean = 169 minutes) for the epinephrine 1 : 100,000 group. Eleven subjects were observed above the mean for both groups. Eighteen subjects reached at least 120 minutes of complete anesthesia with the epinephrine 1 : 200,000 group, and 17 subjects with the epinephrine 1 : 100,000 group.

Both solutions did not show statistically significant differences regarding PL (P = .47), CPA (P = .88), PA (P = .46), and AST (P = .85). Figure 2 shows the results of parameters evaluated.

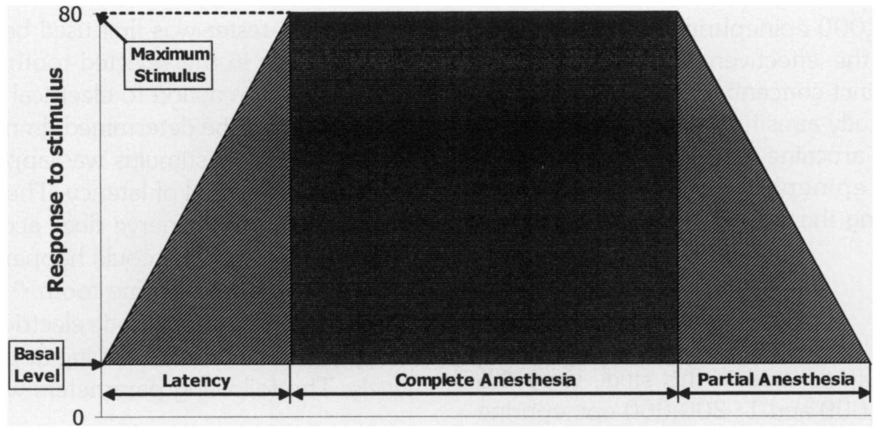


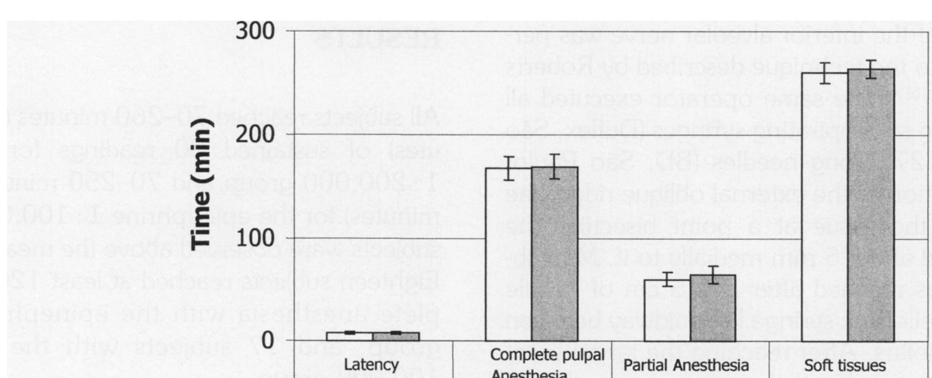
Figure 1. Determining anesthesia parameters.

DISCUSSION

The methodology used in this study is reliable; it is useful to observe anesthesia parameters. Special care regarding some methodology aspects was observed. Healthy volunteers were included with similar age and intellectual backgrounds according to a previous study.[21] The experimental sessions were conducted at the same time to avoid circadian cycle and climate interference.[23] All anesthesia procedures in the present study were conducted in the morning during summertime. All of these factors, including the correct selection of local anesthesia technique performed by just 1 operator, are necessary to validate the results.[24]

An assessment of parametric values using the electric pulp tester has advantages over other methods such as cold, heat, and pressure, as it quantifies the anesthesia even when it is incomplete.[23] Anesthesia symptoms in the soft tissues are subjective and depend on the subject interpretation of pain, and very often the soft tissues may be anesthetized, but not the tooth. The electrical stimulus applied directly on the tooth surface is more precise and objective.[16]

The number of subjects used in the present study was the same or very close to the one observed in other studies comparing local anesthetics in dentistry.[25–27] Only 1 previous study compared the efficacy of 4% articaine with 1 : 100,000 and 1 : 200,000 epinephrine during inferior alveolar nerve block.[28] These authors obtained PL of 2.0 ± 0.9 and 2.8 ± 2.2 minutes, CPA of 288 and 272 minutes, and PA of 30 and 46 minutes for epinephrine 1 : 100,000 and 1 : 200,000, respectively. They obtained values lower than the ones observed in the present study with respect to the PL and PA for both groups, but higher values for CPA. Such differences could be induced by methodological differences. Also, during various clinical procedures the authors evaluated anesthesia parameters after the injection of 6 different volumes of anesthetic solutions in adults and children by 6 different clinicians using various anesthetic techniques (regional block and infiltration) and the electrical stimuli were applied to many different teeth.



	Latency	Complete pulpal Anesthesia	Partial Anesthesia	Soft tissues
□ 4%articaine/epinephrine1:200,000	8 ± 6	168 ± 50	61 ± 33	260 ± 45
□ 4%articaine/epinephrine1:100,000	7 ± 4	169 ± 52	66 ± 39	264 ± 37

Figure 2. Parameters in minutes (mean ± standard error mean) for the inferior alveolar nerve block with 4% articaine and 1 : 200,000 and 1 : 100,000 epinephrine.

No statistical difference ($P < .05$) was observed with regard to the PL, CPA, PA, and AST between the 2 epinephrine concentrations, 1 : 100.000 and 1 : 200,000, indicating that epinephrine concentration did not affect the anesthetic efficacy of inferior alveolar nerve block.

Since there are few studies comparing articaine with different epinephrine concentrations, studies using other local anesthetics showed that the anesthesia efficacy was not proportional to the amount of epinephrine in the solution. A comparison among 3 different concentrations of epinephrine (1 : 50,000, 1 : 100,000, and 1 : 200,000) associated with 2% lidocaine in inferior alveolar nerve block could not show statistically significant differences among them.[29]

A double-blind study[30] tested the optimal concentration of epinephrine (1 : 50,000, 1 : 250,000, 1 : 750,000, and 1 : 1,000,000) added to 2% lidocaine in inferior alveolar nerve block (1.0 mL) before dental extraction in 119 patients. The duration of anesthesia was measured with an electric pulp tester in the adjacent tooth to the extracted ones at 15-minute intervals. The use of epinephrine 1 : 250,000 with 2% lidocaine showed the same efficacy when it was compared with 1 : 50,000 concentration. Epinephrine 1 : 750,000 reduced the duration of the anesthesia. However, solutions without epinephrine or with a concentration of 1 : 1,000,000 did not induce anesthesia consistently.[30] In spite of the differences between the 2 methodologies, the results of the present study showed a similar profile, since both solutions showed no difference concerning clinical effectiveness.

Epinephrine, like other vasoconstrictors, is used to increase the duration of anesthesia, to reduce plasma levels of anesthetics, and to diminish systemic adverse effects.[5] However, when unintentionally injected inside blood vessels, plasma concentration of epinephrine will increase. Healthy patients can tolerate these increases, but patients with cardiovascular disorders may not. Therefore, administration of solutions with less vasoconstrictors must be considered.[31]

Although the inferior alveolar nerve (along with buccal nerve) block is usually performed with 1.5 cartridges, the use of 1 or 2 more cartridges is possible, since failure of the inferior-alveolar nerve block is not infrequent (about 30–45% of cases)[32] due to accessory innervations and anatomical variability.[33] In addition, the success of this technique deeply depends on the operator ability,[34] and thus repetition of injection could be required to achieve satisfactory anesthesia.

In spite of the fact that the aspiration procedure could avoid intravascular injection, false-negative results are not uncommon.[35] Therefore, adverse reaction may occur, especially for medically compromised patients.[36] Thus less vasoconstrictor in the solution could be safer. Since 4% articaine with epinephrine 1 : 200,000 has less sympathomimetic effects than epinephrine 1 : 100,000,[37] our results indicate that it is possible to use a lower concentration of epinephrine without reduction on efficacy in inferior alveolar nerve block.

In conclusion, solutions of 4% articaine with epinephrine 1 : 100,000 or 1 : 200,000 presented the same clinical effectiveness in blocking the inferior alveolar nerve.

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